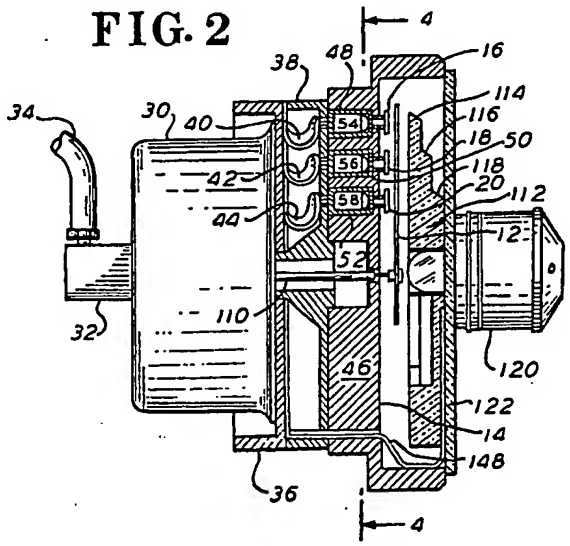
(12) UK Patent Application (19) GB (11) 2 020 010 A

(21) Application No. 7914597
(22) Date of filing 26 Apr 1979
(23) Claims filed 26 Apr 1979
(30) Priority data
(31) 899929
(32) 26 Apr 1978
(33) United States of America (US)
(43) Application published 7 Nov 1979
(51) INT CL²
G01D 13/26
(52) Domestic classification
G1A A3 D10 D11 G11 G1 G2 G6 G9 MR P16 P17 P1 P5 R7 S3 T15 T25 T3 T8
G1J 1G1
G1L 3B2 3F4A 3P 3Q
(56) Documents cited
GB 815116
GB 587055
(58) Field of search
G1A
G1J
(71) Applicant
Airco Inc.,
85 Chestnut Ridge Road,
Montvale, New Jersey 07645,
United States of America
(72) Inventor
George Douglas Jones
(74) Agent
R.W. Obee

(54) **Apparatus for detecting the position of a moveable pointer**

(57) In a system for detecting the position of pointer 12 of a gauge, a stationary light source 120 is positioned adjacent the pointer and lens 112 receives the light from the source and redirects it in elongated light beams directed toward the pointer. Light sensitive detectors 54, 56, 58 are along arcuate paths having centres positionable of curvative coincident with pivot 110 and are located on the opposite side of the pointer from the light source. The arcuate paths generally follow the particular shapes of the light beams that are directed toward the pointer. The light detectors sense when the pointer passes across them so as to substantially reduce the amount of light which they receive. In this manner the detectors signal when the pointer passes pre-set points determined by the positions of the detectors.

FIG. 2



GB 2 020 010 A

2020010

FIG. 1

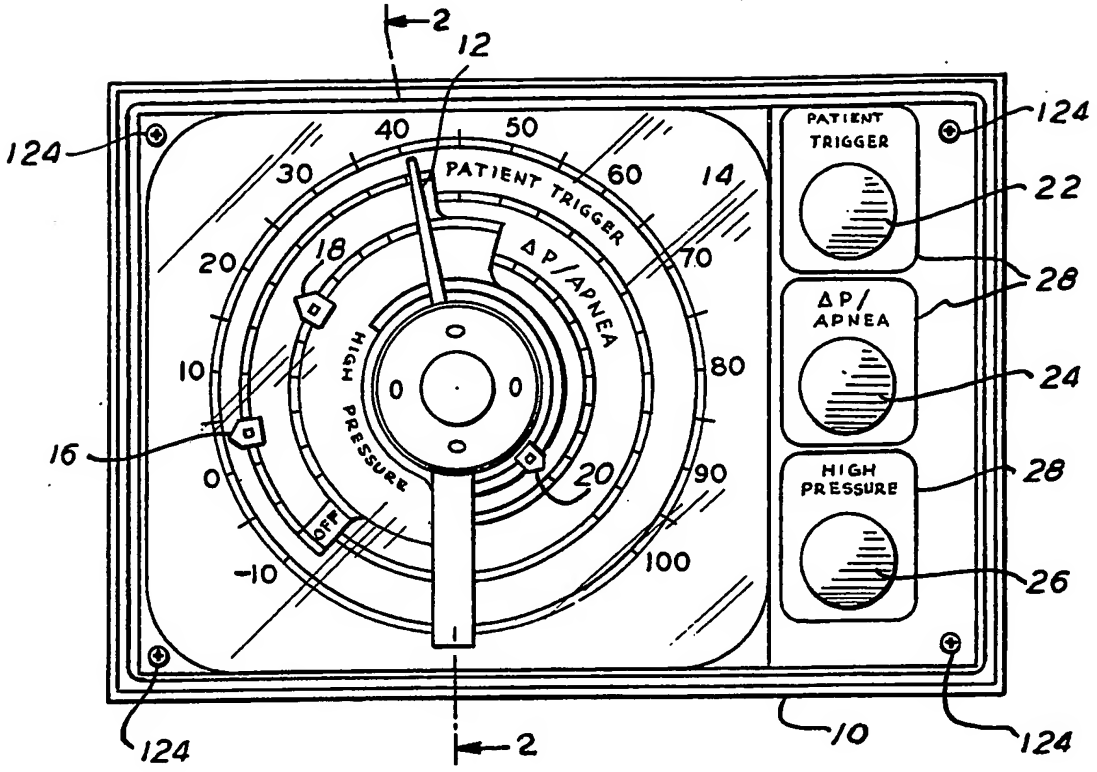


FIG. 2

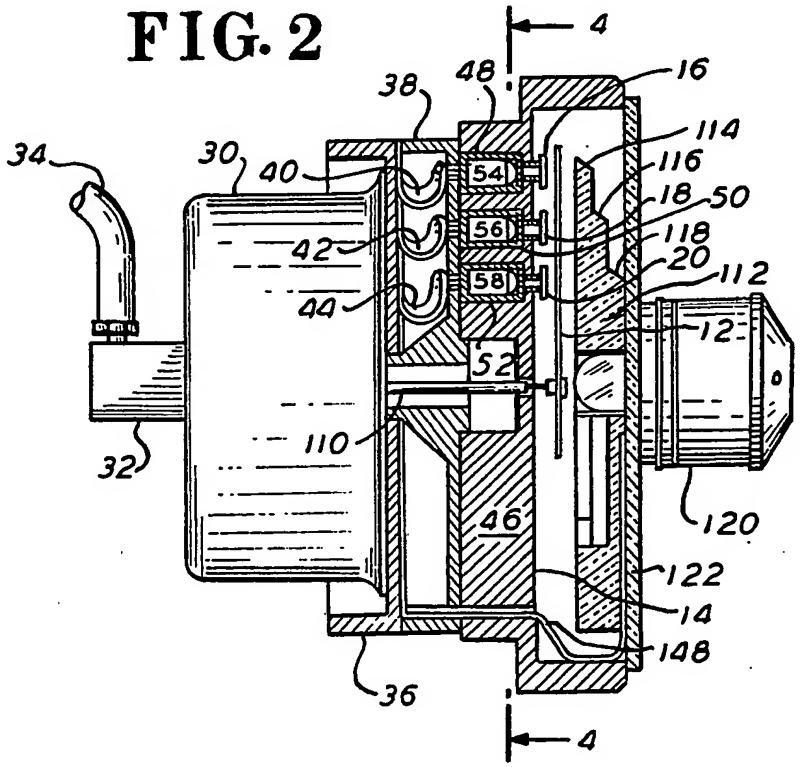


FIG. 4

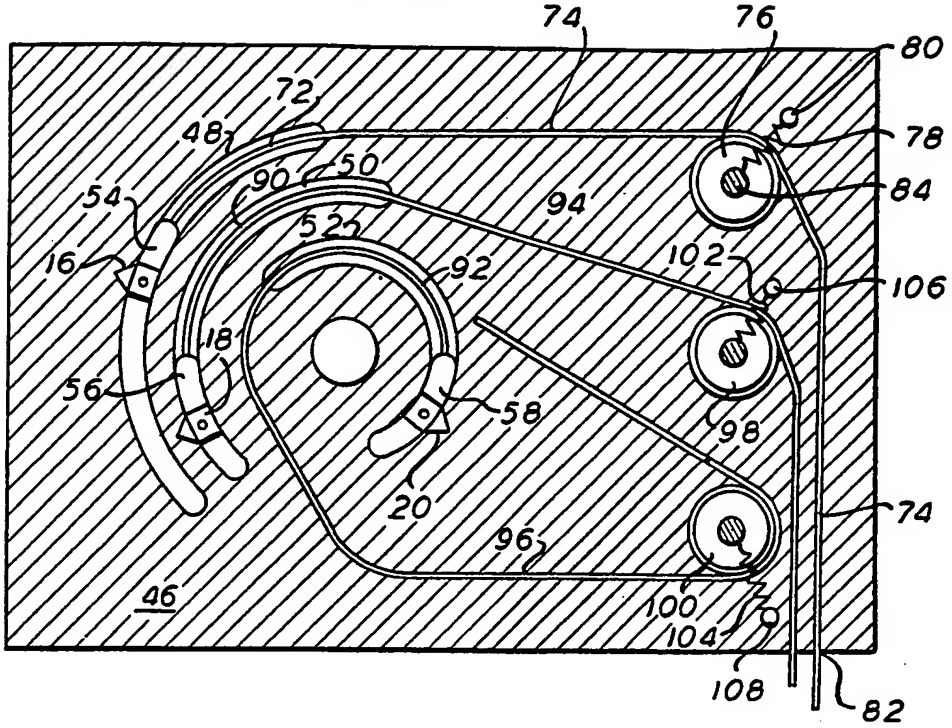


FIG. 3

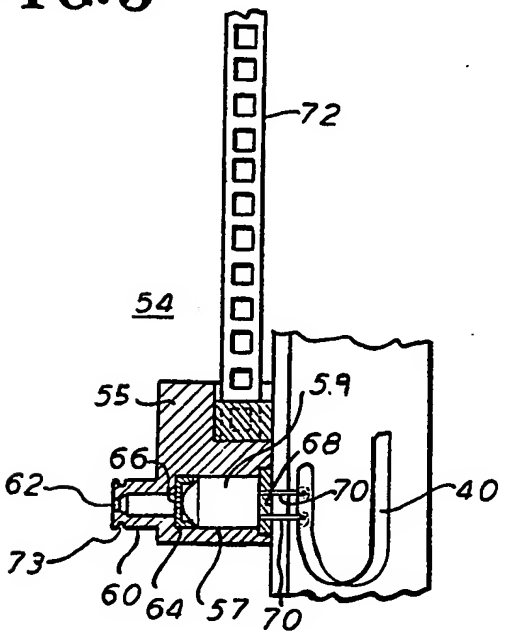
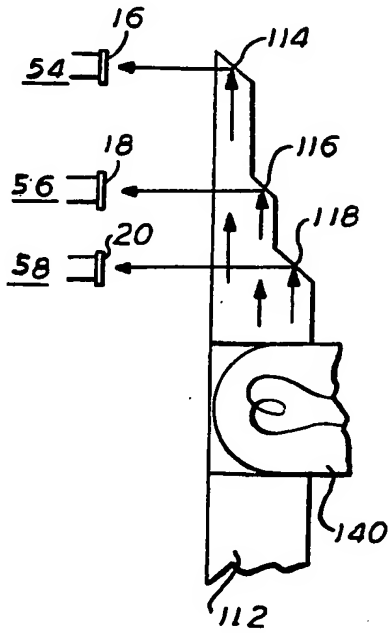


FIG. 6



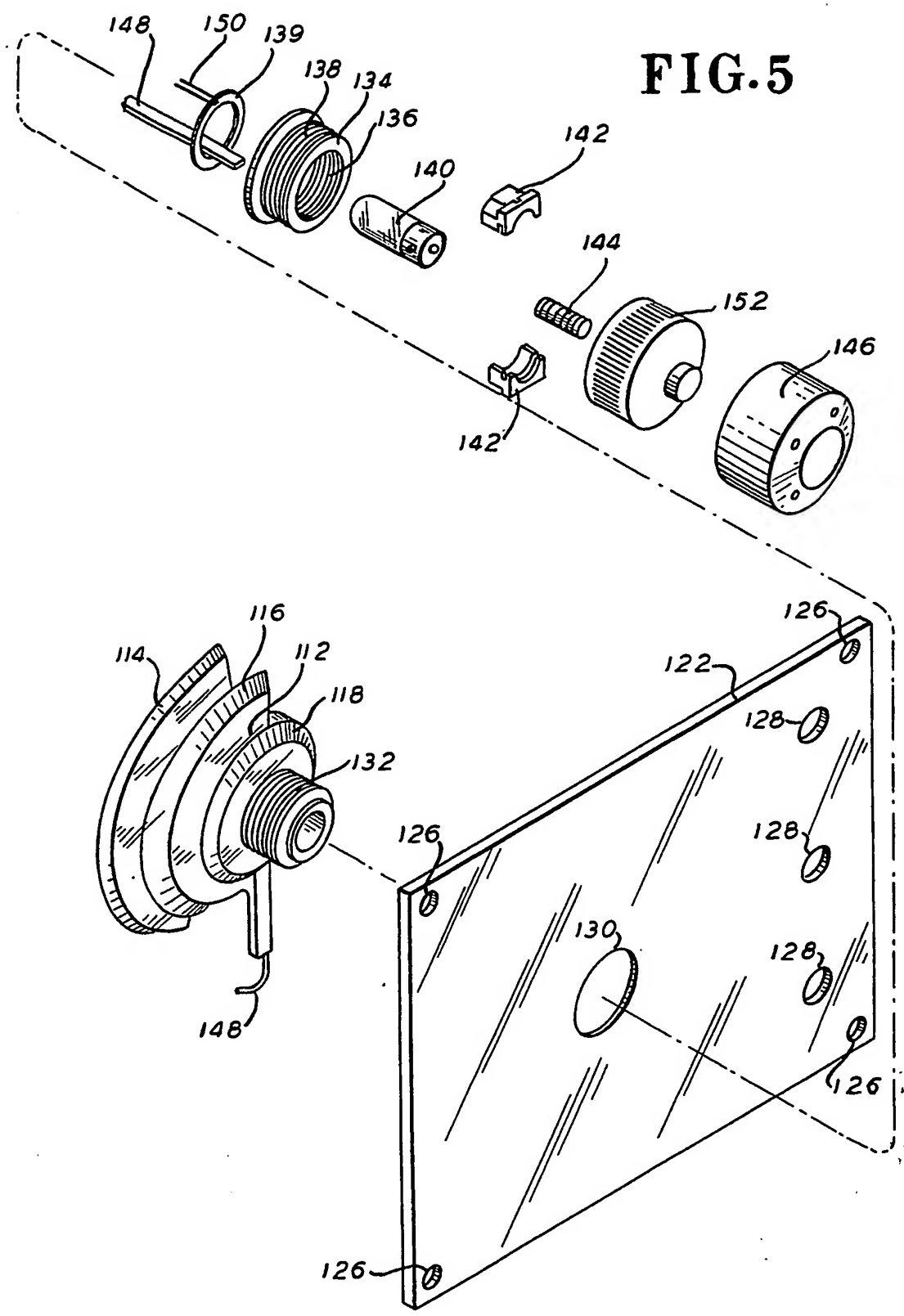

148
150
139
138
134
136
140
142
144
152
146
142
116
114
112
118
132
148
126
122
128
126
128
130
128
126
126

FIG.5

SPECIFICATION

Apparatus for detecting the position of a moveable pointer

The invention relates generally to meters having indicating pointers, and more particularly, to a system for detecting the location of the pointer.

There has been devised many types of meters having means to detect the position or movement of the pointer, however, most suffer from one or more detriments as a result of the detecting means. Basically they can be broken down into broad categories as contacting and non-contacting type. In the contacting type of detecting means, the needle makes physical contact with the detecting means and such contact may make or break an electrical switch so that the needle contact is sensed.

The contact type of detecting systems generally have the inherent problem that the physical contact in some way affects the otherwise free movement of the pointer. In most sensitive meters, a great deal of stress is put on the lack of friction in the movement to minimize any forces which could impede free movement of the pointer to insure that, to the extent possible, the pointer movement precisely responds to the particular parameter that the pointer is sensing.

In the non-contact type of detecting system, some means is employed such that there is no physical contact between that means and the pointer. Most popular of the non-contacting type detecting systems include magnetic pick-ups and photoelectric devices. It is the latter method to which the present invention pertains.

Prior art detecting systems of the photoelectric type have included various means. For example, one such system includes an individual light source and individual light detector. The light source is aimed at a particular position and, as the pointer passes that position, the light is reflected off the pointer to the light detector. A difficulty, of course, of such detecting system is the lack of easy adjustment in the event some other pointer position is desired. Both the light source and light detector must then be carefully adjusted such that the new position be sensed. Alternatively, for different positions, one could utilize a plurality of such individual light sources, accurately directed toward a plurality of light sensors.

Obviously, the difficulties of plurality of sensors and detectors increases as does the number of such sensor and detectors as each must be accurately set to the desired pointer location and one still must sacrifice the possibility of sensing a pointer position intermediate an individual light source and light detector. Since the number of such sources, etc. must be finite, the number of detectable positions also is finite.

As a further example of the prior art, other arrangements have placed the light source on the end of the pointer itself such that the light source moved with the pointer and thus could be detected in various positions of the pointer, with the light detector being adjustable to such various positions. A difficulty in such arrangement involves the difficult task of replacing such bulb and in the cost of manufacturing and installing a pointer with a light source at its end. Also, since many gauges having pointers are extremely sensitive, it is disadvantageous to add any weight to the pointer in that it thus adds additional drag to the pointer bearings and can slow the needle movement in responding to a change in the sensed parameter.

Other difficulties inherent in prior art methods when light sources and/or light detectors are used outside the face of the gauge include a lessening of the visibility of the gauge pointer.

In instances where the gauge is monitored by a person such that undistorted visibility is a must, the face must be as uncluttered as possible by any interfering devices.

The present invention seeks to overcome the foregoing difficulties inherent in the prior art pointer detecting systems and accordingly resides in apparatus for detecting the position of a moveable pointer comprising light means adapted to direct from one side of the pointer an elongated beam of light extending generally along the path of movement of the pointer, and detector means adapted to be located on the other side of the pointer and to be adjustably positioned, preferably in an infinite number of positions, along said elongated beam of light, said detector means being adapted to sense a diminishment of the intensity of the light incident thereupon when the pointer is positioned to interrupt light from said beam falling upon the detector means.

The invention also resides in a meter having a pointer adapted to move in response to changes in a detected parameter and including apparatus for detecting the position of said pointer as defined above.

The invention furthermore resides in a medical respirator for delivering gas to a patient and including a pressure gauge having a pointer adapted to move in response to changes in the pressure of gas delivered to the patient, the pressure gauge including apparatus for detecting the position of said pointer as defined above.

Preferably, said light means comprise a stationary light source and lens means adapted to reflect light from said source into said elongated beam. Once the position of the light source has been fixed it need not be altered or moved in any way thereafter by the user to redirect its light either in initial setup or for any desired changes in operation or set point. The light source itself may be of a conventional form, readily obtainable, and is preferably located outside of the associated meter mechanism such that it can easily be changed by the operator in case it burns out. A bulb failure is instantly recognizable.

Also, the lens can be easily manufactured of plastics and may be adaptable to different pointer movements. For instance, the invention is more particularly described hereinafter in connection with a dial gauge wherein the pointer rotates about an axis. The lens therefore produces an arcuate light beam directed toward the pointer. However, the lens can easily be manufactured to produce a straight elongated beam to accommodate other types of meters.

Also, the lens may produce a plurality of elongated light beams of varying lengths and positions in order to allow the use of a plurality of detectors located, for example, on different radii about a radially moving type gauge pointer.

The lens may be transparent in its entirety, thus creating no obstruction to the dial visibility. The light detector can be of generally conventional design since the needed sensitivity can be achieved by devices currently on the market. Since the lens can create a concentrated elongated light beam, the difference in light intensity can be readily sensed when the beam is interrupted by the pointer, yet the light detector can operate under normal outside light without causing a false detection or impairing a legitimate detection if one should occur. Therefore, the effect of outside light is essentially minimized.

Since the light to be detected is in the form of an elongated beam, a single light detector can be used in each such beam and yet the position of that sensor can be varied in an infinite number of positions along the beam. The movement and setting of the light detector position may be accomplished through a knob located on the face of the associated gauge, therefore its setting can be easily made by the operator without taking the gauge apart. Also, when set, the actual setting can be visually percieved by the user and its location determined in accordance with indicia on the gauge dial itself. Thus, for example, if the operator desires to detect the movement of the pointer past a particular setting, e.g. 80 psi, in the case of a pressure gauge, he actually moves and sets the light detector to 80 psi.

The present invention has further overall advantages, in that the detection apparatus is independent of the gauge mechanism, thus it does not impose any drag on the pointer operation. It can therefore be used with the most sensitive instruments without affecting the accuracy or response. In addition, the invention not only allows an individual light detector to be infinitely adjustable about a 360° radial dial, but can employ a plurality of such detectors to be placed around the 360° arc, either in the same radius of travel or in a plurality of radii in case some overlapping settings are devised.

Finally, the detection apparatus of the present invention can be retrofitted to conventional gauges rather than require manufacturing of a complete gauge and detection apparatus. The apparatus is thus adaptable to different kinds of gauges without requiring an entire manufacturing change to build various gauges such as ammeters, voltmeters, pressure gauges and the like.

The invention will now be more particularly described, by way of example, with reference to the accompany drawings, in which:

Figure 1 is a front view of a gauge incorporating pointer detecting apparatus in accordance with the present invention;

Figure 2 is a cross-sectional view taken along the line 2-2 of Figure 1;

Figure 3 shows, to an enlarged scale, one of the light detectors of Figure 2;

Figure 4 is a cross-sectional view taken along the lines 4-4 of Figure 2;

Figure 5 is an exploded view showing the assembly of the lens and light source of the present invention; and

Figure 6 is a schematic view showing the path of light directed by the lens used on the present invention.

In Figure 1 there is shown a gauge 10 having incorporated thereon, a system for detecting the position of its pointer 12. The faceplate 14 of the gauge 10 has printed thereon certain indicia depending upon the particular type of gauge or meter concerned. The present invention will be described in terms of a pressure gauge used on a medical respirator and having a radially moving pointer. However, the detecting system can obviously be used on most types of gauges, or meters, or dials, including ammeters, voltmeters, pressure gauges, vacuum gauges and the like. It is to be noted, however, that the use of this detecting system on a medical respirator is believed particularly beneficial to a respirator by offering certain centralized control settings that constitute an improvement in a respirator. As noted on the particular indicia of Fig. 1, the numbers refer to pressure in CMH_20 and the gauge 10 itself is a compound gauge, that is it measures both positive and negative pressures (vacuum).

As shown, therefore, such indicia range from a -10 CMH_20 to an upper point of 100 CMH_20. A plurality of set point indicators are positioned about the faceplate 14, and represent various set points of the patient trigger indicator 16, Δp indicator 18, and high pressure indicator 20, the function of the indicators to be later explained. Each of the indicators 16, 18 and 20 correspond, however, to setting knobs 22, 24 and 26 which extend forward from the gauge 10. Each knob 22, 24 and 26 includes suitable labeling 28 to indicate its particular function to the user.

Turning now to Fig. 2, in cross-section, the various components of the detection system are shown on a standard pressure gauge having housing 30 containing the normal elements of a diaphragm type pressure gauge. The internal workings of the pressure gauge within housing 30 are not shown inasmuch as such workings can be readily purchased and form no part of the present invention except for the normal operation of a pressure gauge. The housing 30 has some suitable inlet connection 32 which is connectible to tubing 34 through which the pressure signals are transmitted to gauge 10.

A gauge mount 36 is attached to the housing 30 to provide support for remaining structure of the detection system. The gauge mount 36 normally has drilled holes (not shown) to receive cap screws (not shown) which screws the gauge mount 36 in place to threaded holes within housing 30, which threaded holes are normally used in conventional pressure gauges to receive similar cap screws which serve to secure the front dial containing portion thereto.

There is mounted upon gauge mount 36, a circuit housing 38 which serves to provide room for movement of flex circuits 40, 42 and 44, the function of which will be later explained.

A main housing 46 is affixed to circuit housing 38 by suitable means (not shown) and has a plurality of arcuate shaped grooves 48, 50 and 52 formed

therein. As previously explained, the detecting system may be utilized with a singular groove and, in addition, may be straight rather than arcuate, however, in the device being described and which was designed for a medical respirator, a plurality of grooves has been used.

Each of grooves 48, 50 and 52 form the arcs of a circle having the same center point but having different radii. The grooves 48, 50 and 52 each have a narrower width portion toward the front surface of housing 46 on which the faceplate 14 is secured.

Within each of the grooves 48, 50 and 52 there is positioned a light detector means 54, 56 and 58 respectively which are adapted to slide within said grooves.

In Fig. 3, one of the light detector means 54 is shown in detail, which is typical of each of the light detector means used herein. The light detector means 54 includes a molded carriage 55 having a recess 57 within which is placed a light sensor 59. The light sensor 59 is of commercially available miniature type, solid state and which transmits a signal upon light impinging upon its light sensitive surface.

The light detector means 54 further includes a forward extension 60 which is adapted to fit within the narrower width portion of groove 48 in Fig. 2. The main body of light detector means 54 fits within the wider portion of grooves 48 such that the light detector means 54 slides freely within groove 48 yet is also contained therein. A tiny front opening 62 is formed in the forward extension 60 to receive light as will be explained. A mask 64, also having a tiny aligned opening 66 is fitted within the recess 57 and held thereon by the light sensor 59. As will later become apparent, the two aligned openings 62 and 66 serve to prevent the undesired entrance of light from any other extraneous source other than the intended light source.

The light sensor 59 is retained within recess 57 by means such as staking with hot soldering iron at 68. Suitable electrical leads 70 extend to connect to the flex-circuit 40.

The other end of flex-circuit 40, as well as flex-circuits 42 and 44 in similar manner, extend to a mounted circuit board (not shown) and thence are fed, externally to the gauge 10, to suitable electronic circuitry. The electronic circuitry is not shown since normal, state of art, amplifiers can be used to detect the signal from one of the light sensors to thereafter provide a useful signal.

A carriage drive strap 72 is affixed to light detector means 54 and extends therefrom, the purpose of which will be later explained.

To complete the description of the light detector means, a small groove 73 is formed in the outer end of forward extension 60 and which is adapted to receive an indicator 16 after the light sensor is installed within the groove 48.

Turning briefly to Fig. 4, the mechanism for moving the light detector means 54 may be described. As shown, the carriage drive strap 72 extends from light detector means 54 through the groove 48 and enters a curved channel 74 formed in housing 46. The carriage drive strap 72 is engaged by a roller 76 which is retained in frictional engagement by means of spring 78 attached between the roller 76 and a post 80 to bias the roller 76 toward the carriage drive strap 72 to maintain good frictional engagement therebetween. The carriage drive strap 72 thereafter continues in channel 74 and, depending upon the desired radial movement of light detector means 54, may even be permitted to extend external of housing 46 through opening 82.

The roller 76 rotates about its shaft 84 on which is secured the knob 22, shown in Fig. 1. Accordingly, as the knob 22 is turned by a user, roller 76 also rotates and serves to move carriage drive strap 72 in channel 74, thereby causing corresponding movement of light detector means 54.

As previously shown on Fig. 1, the indicator 16 which is affixed to light detector means 54 thereby can be moved to any desired position along the groove 48 and the indicator 16 will show on the face plate 14 indicia, that setting (in this case, pressure) at which the light detector means 54 is positioned.

In similar manner, the remaining light detector means 56 and 58, also having indicators 18 and 20 respectively, can each be moved within their respective grooves 50 and 52 by carriage drive straps 90 and 92 moving through their channels 94, 96. In each instance a suitable roller, shown as 98 and 100, drive the carriage straps 90 and 92 by frictional engagement and by springs 102 and 104 secured to posts 106 and 108. As may be seen with respect to the carriage drive strap 92, due to the relatively short desired distance in which light detector means 58 moves, the carriage drive strap 92 may end within the confines of the housing 46.

Hence, the knobs 22, 24 and 26 may be rotated to a desired position by an operator, and in doing so, the light detecting means 54, 56 and 58 will be correspondingly moved to the proper position. The operator can visually ascertain the exact position of each individual light detecting means by noting the position of pointers 16, 18 and 20 with respect to the particular indicia on faceplate 14. Returning to Fig. 2, there is further shown the pointer 12 in a position overlying each of the pointers 16, 18 and 20. It should be noted that all three of the pointers 16, 18 and 22 are shown in the same radial position in Fig. 2 for clarification and do not correspond to their respective positions in Fig. 1.

The pointer 12 is attached to the original pointer shaft mechanism within housing 30 by means of a shaft extension 110 which slips functionally over the original pointer shaft and the other end is inserted into a hub on the pointer 12.

On the outside of the pointer 12, that is, the side of the pointer 12 facing away from light detector means 54, 56 and 58, there is provided a lens 112 having a plurality of arc-shaped elongated facets 114, 116 and 118. A light source, generally shown at 120 provides light to be shaped by lens 112 as will be later explained.

The assembly of the lens 112 and light source 120 can readily be seen by reference to Fig. 5. In Fig. 5 there is shown a transparent cover plate 122 which is adapted to be attached to the housing 46 by means such as screws (shown as 124 in Fig. 1) through

holes 126. Other control knob holes 128 are also provided in the cover plate 122 through which the shafts for knobs 22, 24 and 26 protrude when the overall gauge is assembled.

A central opening 130 through cover plate 122 receives a threaded extension 132 of the lens 112. The lens 112 is secured to faceplate 122 by a nut 134 having internal and external threads, respectively, 136 and 138. The internal threads 136 of nut 134 are screwed to the threaded extension 132 of lens 112. A conductor ring 139 contacts nut 134 and is connected to a suitable electrical power source by flexlead 150.

A conventional light bulb 140 is locked into position inside extension 132 by split locking contacts 142 which retain the contact end of the bulb 140 in a position such that the light portion of bulb 140 containing the filament protrudes within lens 112. The bulb 140 is retained in its position by spring 144 bearing against lamp housing 152. The entire assembly containing bulb 140 is then affixed to the transparent cover plate 122 by cover 146 which is screwed to the outer threads 138 of the nut 134. A second electrical conductor is provided to the bulb 140 by flex conductor 148 which runs through lens 112 to the case of the bulb 140. Flex conductor 150 is soldered to conductor ring 139 which contacts nut 134, housing 152 and spring 144 which contacts back of bulb 140.

The light path of the elongated light beam can be seen in Fig. 6. The centrally located light bulb 140 directs the light within lens 112 toward the plurality of arcuate facets 114, 116 and 118 where the light is reflected at approximately a 90° angle toward the light detectors 54, 56 and 58 which are located immediately behind indicators 16, 18 and 20. In this manner, the light is formed into an elongated beam and the light detectors 54, 56 and 58 are movable generally along the path of that beam.

Inasmuch as the present invention has been particularly adapted and described for use on a medical respirator for which it has distinct advantages, its overall operation will be described with reference to such a respirator.

In such a respirator it is useful to provide a certain simplicity of controls for the operator who has the responsibility of setting certain parameters within which the respirator operates. Basically, the function of a respirator is to breathe the patient, that is, to force air at a predetermined pressure and/or volume into a patient at certain intervals. Such respirators normally include a pressure gauge so that the attending personnel can visually monitor the pressure within the patient circuit, that is, within the tubing that introduces the air into the patient. This monitoring is necessary so that such personnel knows the pressure of air being delivered to the patient and also provides a positive indication that the respirator is operating properly.

The present invention therefore conveniently replaces conventional pressure gauges showing pressure within the patient circuit or, as an alternate, can be retrofilled to such pressure gauges in an existing respirator to thereby include the desirable control feature and ease of setting certain respirator parameters.

Since the human lungs are reasonably compliant, it is necessary with the use of respirators to include some limit on the maximum pressure delivered to the patient's lungs to avoid overinflation and possible damage thereto.

Thus, one of the useful parameters chosen to be incorporated into the gauge 10 of the present invention is a high pressure alarm which sounds an audible alarm when the pressure within the patient circuit exceeds the particular setting and switches the machine out of inspiration so as not to overpressurize the patient.

As can be seen from Fig. 1, the function of the high pressure alarm is the inside or smallest radius facet 118 of the lens 112. In this instance, the facet 118 extends from approximately 25 CMH_20 to beyond the high figure on the faceplate 14 indicia of 100 CMH_20 and, by adjusting the knob 26, the high pressure indicator 20 can be adjusted to any desired intermediate position within that range. The light source 120 thereby provides light to the lens 112 to reflect the light via facet 118 into an arcuate elongated light beam forming the arc of a circle between the ranges of 25 CMH_20 to 100 CMH_20 on the faceplate 14 of gauge 10. The high pressure indicator 20 moves through corresponding arc as the control knob 26 is turned.

Assuming, therefore, that the attending personnel desires to set the high pressure alarm to sound at 80 CMH_20 by merely turning the control knob 26, he can visually set the indicator 20 at that point in accordance with the indicia on faceplate 14. This positions the corresponding light sensor 58 at that setting and when the pointer 12 passes the sensor 58, it breaks the elongated light beam directed by lens 112 toward sensor 58, thereby causing the sensor 58 to change electrical characteristics. The change in electrical characteristics is detected, amplified and the resulting signal, in accordance with conventional electronic circuitry, actuates the audible high pressure alarm, thereby warning the attending personnel that the pressure in the patient circuit exceeded the desired set limit and switches the machine out of inspiration.

A further useful alarm is shown on the faceplate 14 of the gauge 10 by the legend Δp. This alarm is also to provide the personnel operating the respirator that there is some malfunction in that the patient is not receiving sufficient "breaths" as desired. The purpose of the Δp alarm is to warn the operator that the pressure in the patient circuit is not fluctuating as would be experienced in the normal operation of the respirator. The set point is adjusted in the same manner as explained with respect to the high pressure alarm, however, the Δp has its facet 116 in the intermediate pressure ranges, i.e. -10 CMH_20 to +50 CMH_20 and sounds an audible alarm in case the pointer 12 does not cross the set point every 15 seconds, thereby indicating that a steady pressure, or no pressure, is being maintained within the patient circuit. This alarm can also be set below zero CMH_20 and thus be used during spontaneous ventilation and IMV modes of operation.

Finally, one of the features of some respirators is

its ability to respond to the attempt by a patient to breathe, and thus cause the respirator to function to supply the appropriate gas to the patient's lungs. In such feature, the pressure is sensed as it drops as the patient inhales. In the present invention, the patient trigger feature is easily incorporated into gauge 10 by having an indicator 16 and corresponding light detector 54 which can be set, as explained, by the operator turning control knob 22. Thus, pressure, or vacuum, at which the pointer 12 passes the set point of indicator 16 is used to trigger the respirator to inspire the patient, and again, such control is easily set, easily changed and its setting visually perceived by an operator. Sensing the pointer in this manner allows an operator to set the set point at positive pressures when triggering at elevated base lines while using P.E.E.P. (Positive, End, Expiratory Pressures).

Thus, it may be seen that various features, i.e. alarms, patient triggering, can be easily and conveniently set and adjusted by locating the same about the face of the pressure gauge normally found on medical respirators, yet the gauge itself also carries out its normal function of providing a continuous visual monitor of the respirator operation.

While the present invention has been set forth in terms of a specific embodiment, particularly as used on a medical respirator, it will be understood in view of the present disclosure, that while the pointer detecting system is unique to such medical respirator and thus an improvement in that art, that numerous variations of the invention are now enabled to those skilled in the art and such system useable on various other meters, gauges and the like to detect the position of a pointer.

CLAIMS

1. Apparatus for detecting the position of a moveable pointer comprising light means adapted to direct from one side of the pointer an elongated beam of light extending generally along the path of movement of the pointer, and detector means adapted to be located on the other side of the pointer and to be adjustably positioned along said elongated beam of light, said detector means being adapted to sense a diminishment of the intensity of the light incident thereupon when the pointer is positioned to interrupt light from said beam falling upon the detector means.

2. Apparatus according to claim 1 wherein said detector means are adapted to be positioned in an infinite number of positions along the elongated light beam.

3. Apparatus according to claim 1 or claim 2 wherein said light means comprise a stationary light source and lens means adapted to reflect light from said source into said elongated beam.

4. Apparatus according to claim 3 wherein said light source is substantially a point source and said lens means comprise a facet for receiving light from said source and redirecting said light as said elongated beam.

5. Apparatus according to any preceding claim for detecting the position of a pointer moveable radially about an axis wherein said light means are adapted to direct an elongated beam of light in the shape of an arc of a circle having its centre point located on said axis of the pointer.

6. Apparatus according to claims 4 and 5 wherein said light source is located on said axis and said facet is in the shape of an arc of a circle having its centre point also located on said axis.

7. Apparatus according to any preceding claim wherein said light means are adapted to direct a plurality of said elongated beams of light, and comprising a plurality of said detector means adapted to be ajustably positioned along respective beams.

8. Apparatus according to claims 4 and 7 wherein said lens means comprise a plurality of said facets each for receiving light from said source and redirecting said light as a respective said elongated beam.

9. Apparatus according to claims 5 and 7 wherein said light means are adapted to direct a plurality of light beams in the shapes of arcs of circles of different radii, said circles having the same centre point located on said axis of the pointer.

10. Apparatus according to claims 6 and 8 wherein said plurality of facets are in the shapes of arcs of circles of different radii, said circles having the same centre point located on said axis of the pointer.

11. A meter having a pointer adapted to move in response to changes in a detected parameter and including apparatus for detecting the position of said pointer in accordance with any one of claims 1 to 10.

12. A medical respirator for delivering gas to a patient and including a pressure gauge having a pointer adapted to move in response to changes in the pressure of gas delivered to the patient, the pressure gauge including apparatus for detecting the position of said pointer in accordance with any one of claims 1 to 10.

13. A respirator according to claim 12 including a patient triggering system and/or one or more alarm systems, and including means responsive to the detection by said detecting apparatus of said pointer in one or more predetermined positions to activate said patient triggering system and/or one or more alarm systems.

14. Apparatus for detecting the position of a movable pointer substantially as hereinbefore described with reference to the accompanying drawings.

15. A meter having a pointer adapted to move in response to changes in a detected parameter and including apparatus for detecting the position of said pointer substantially as hereinbefore described with reference to the accompanying drawings.

16. A medical respirator for delivering gas to a patient and including a pressure gauge having a pointer adapted to move in response to changes in the pressure of gas delivered to the patient, the pressure gauge including apparatus for detecting the position of said pointer substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by Croydon Printing Company Limited, Croydon Surrey, 1979.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY,